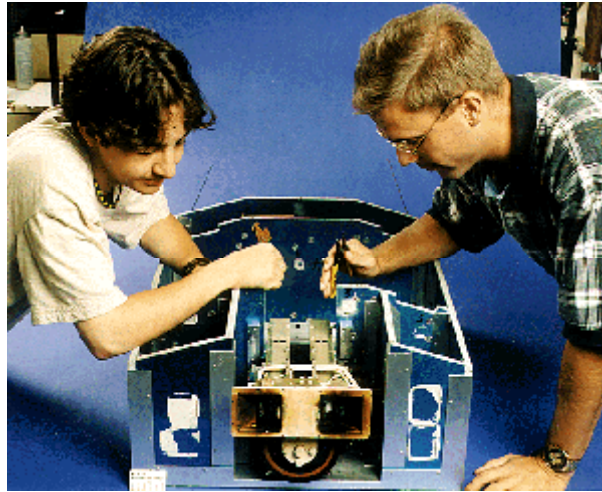


Pulsed Plasma Thruster Technology



LES 8/9 pulsed-plasma thruster mounted on the JAWSAT spacecraft bus in preparation for integration testing at Lewis.

The continuing emphasis on reducing costs and downsizing spacecraft is forcing increased emphasis on reducing the subsystem mass and integration costs. For many commercial, scientific, and Department of Defense space missions, onboard propulsion is either the predominant spacecraft mass or it limits the spacecraft lifetime. Electromagnetic-pulsed-plasma thrusters (PPT's) offer the combined benefits of extremely low average electric power requirements (1 to 150 W), high specific impulse (~ 1000 sec), and system simplicity derived from the use of an inert solid propellant. Potential applications range from orbit insertion and maintenance of small satellites to attitude control for large geostationary communications satellites.

Although PPT's have operated on several spacecraft, there has been no new PPT technology development since the early 1970's. As a result of rapid growth in the small satellite community and the broad range of PPT applications, the NASA Lewis Research Center has initiated a development program to dramatically reduce the PPT dry mass, increase PPT performance, and demonstrate a flight-ready system by October 1997. The flight system is being built under a contract with Olin Aerospace. A recent report (ref. 1) summarized the results of a series of near-Earth mission studies, including both primary and auxiliary propulsion and attitude control functions and reviewed the status of NASA's ongoing development program.

The baseline technology for the new development program is the Lincoln Experimental Satellite (LES) 8/9 PPT, which was flight qualified in 1970 with a fueled system mass of 7.0 kg and provides 10,000-N-sec total impulse. The program objectives are to decrease the fueled system mass to 3.5 kg while doubling the total impulse capability to 20,000 N-sec. These objectives are being accomplished via the use of recently developed capacitors, integrated circuit technology for both telemetry and power electronics, new structural materials, and an increase in PPT performance.

Efforts to date have demonstrated a factor of 2 reduction in mass and volume for the power converter, ignition, and logic/telemetry systems. In addition, lightweight capacitors have been selected and are undergoing life testing in a new PPT discharge simulator. Spacecraft integration assessments are also underway, with testing of contamination, electromagnetic interference, and Global Positioning System compatibility. This testing is currently focused on integrating an old LES 8/9 PPT on the Joint Air Force/Weber State University Satellite (JAWSAT), a small educational satellite to be launched in 1997 (see figure). The PPT program is on target to deliver a new, lightweight flight-qualified system in October 1997.

Reference

1. Myers, R., et al.: Pulsed Plasma Thruster Technology for Small Satellite Missions. NASA CR- 1984271995